Chapter 17

# Planning Integrated Faecal Sludge Management Systems

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Learning Objectives

- Understand the importance of an integrated approach for faecal sludge management.
- Learn how to plan a faecal sludge management project on a city level, including a logical framework of the necessary activities.
- Understand how to select context appropriate options and to determine the critical selection factors in each specific context.
- Be able to link the different aspects developed in the book (e.g. management, finance, stakeholders' interests, technology, local environment) and understand how they are connected and influence each other.

## 17.1 INTRODUCTION

The process leaders who are designated with the responsibility for planning and implementing a city-wide faecal sludge management (FSM) system (Case Study 17.1) often face a complicated situation, characterised by diverse levels of service and a patchwork of uncoordinated and independent stakeholders managing various activities. FSM planning aims to transform such a complex situation into a well-organised and coordinated management framework, which is usually initially expressed in the form of a city sanitation plan or citywide sanitation strategy (Case Study 17.3) and later translated into action plans and concrete implementation. This is no easy task as stakeholders have different and even conflicting interests, needs and constraints (Chapter 15). However, it is a crucial task, as urban sanitation planning is the key to sound investment (WSP, 2009) and clear action plans greatly assist in sourcing funding. If donor money is being sought, a detailed plan with a clear strategy will be necessary. The problem with urban sanitation is not only a lack of investment, but also the lack of a plan.

FSM planning is about understanding and matching stakeholders' interests, needs and constraints with an appropriate and accepted management scheme (Chapter 12) and financial mechanisms (Chapter 13). It is also about assessing capacity building and needs for empowerment (Chapters 15 and 16). Such understanding can only be acquired through a thorough assessment of the initial situation

(Chapter 14). Experience in FSM shows that every solution should be context-specific and integrated. Moreover, experience in Asia demonstrates that any number of approaches can be successful when implemented in conjunction with a comprehensive legal and regulatory framework, clear delineation and appropriate delegation of roles and responsibilities, and dedicated public funding (AECOM and SANDEC/EAWAG, 2010).

At the beginning of such a complex task, it is not easy to know where to begin, how to collect and structure the necessary information, or how to work with the key stakeholders in order to reach a sustainable system.

In this chapter, an integrated planning approach is proposed, in order to facilitate the work of a planner or engineer in a city and to bind together the different activities and ideas presented in this book in a logical and structured way. This integrated approach is described in Section 17.3 and reflected in two key elements: the FSM planning framework (Table 17.1) and the technology selection scheme (Figure 17.8). The Planning Framework highlights the essential tasks and activities and can be used as a template or an aid when getting started, whatever the city in question. As for the Technology Selection Scheme, it proposes an elimination-based approach based on the local context and the interest for enduse.

Figure 17.1 The city of Elmina, Ghana (photo: Philippe Reymond).

Table 17.1 Faecal sludge management planning framework

# FSM planning from A to Z

| Standard project phases | | Activities | Outcomes | Chapters | Participatory stages: CLUES | Participatory stages: SAN21 |
|---|---|---|---|---|---|---|
| Exploratory study | A | Preliminary assessment of the initial situation and first inventory of stakeholders | Overview of the situation; facilitators are identified | 14<br>15 | Process ignition | Establish a city sanitation task force |
| | | **Inception report** | | | | |
| Preliminary (pre-feasibility) studies | B | Identification and preliminary characterisation of the stakeholders and their relationships | All stakeholders are identified and characterised | 15 | Launch of the planning process | Understand the existing context |
| | C | Initial launching workshop, including field visit with all the stakeholders | Stakeholders are sensitised to sanitation reality and aware about the project's objectives | 16.5 | | |
| | D | Assessment of:<br>- Sanitation practice and needs, reuse interests<br>- Institutional setup, government support<br>- Legal and regulatory framework<br>- Existing organisational modes<br>- City structure and heterogeneity of sanitation practices<br>- Existing financial flows<br>- Climate | Sanitation practices are identified, as well as urban heterogeneity;<br>Strengths, weaknesses, opportunities and threats are identified (SWOT analysis);<br>The enabling environment is described | 14 | Detailed assessment of the current situation | |
| | E | Selection of potential organisational modes | Orientation of the process towards realistic options | 12 | | |
| | F | Identification of sites for treatment | Stakeholders have indicated existing and potential sites | 14.4 | | |
| | G | Characterisation and selection of key stakeholders | Stakeholder who have interest in and/or influence on the process are identified | 15.4 to 15.5 | | |
| | | **Preliminary studies report** | | | | |
| Feasibility study | H | Quantification and characterisation of sludge | Process leaders know what has to be treated | 2 | Identification of service options | Identify viable solutions |
| | I | Characterisation and selection of sites | Appropriate sites are selected | 14.4 | | |
| | J | Preselection of combinations of technologies, organisational modes and financial mechanisms | Scenarios are elaborated | 5,11,12,<br>13,15,17 | | |
| | K | Detailed evaluation of selected options, including:<br>- Requirements of technology combinations, pros and cons, O&M<br>- Organisational mode and institutional setup; roles & responsibilities; contractual arrangements<br>- Capital and operation costs, financial mechanisms, estimated budget<br>- Skills required to run each system<br>- Environmental impact assessment | System scenarios are evaluated and optimised | 4-17 | | |
| | L | Preliminary presentation of the results to the key stakeholders | Stakeholders are consulted and agreement is secured | 16 | | |
| | M | Final selection of system options | | 17 | | |
| | N | Workshop : Validation of chosen options by all the stakeholders | Proposals are validated by all stakeholders | 16.5 | | |
| | O | Reassessment of key stakeholders according to the validated options | Influence and interest of stakeholders are reassessed according to the previous decisions | 15.5 | | |
| | | **Feasibility study report** | | | | |
| Detailed project development | P | Detailed project development (Action Plan):<br>- Detailed design of the treatment plant<br>- Detailed definition of roles & responsibilities<br>- O&M management plan with clear allocation of costs, responsibilities and training needs<br>- Conventions between stakeholders, securing financial and institutional mechanisms<br>- Strategy for control and enforcement<br>- Definition of needs for capacity building and job creation<br>- Definition of contracts and bidding processes<br>- M&E strategy for the implementation phase<br>- Timeline for implementation with distinct phases and an itemised implementation budget | The Action Plan is written;<br>The whole system is described in detail | 11<br>12<br>13<br>16<br>17 | Development of an Action Plan | Elaborate Strategic Plan |
| | Q | Workshop : Presentation of the Action Plan | The Action Plan is validated by all stakeholders | 16.5 | | |
| | R | Reassessment of key stakeholders according to Action Plan | Roles and responsibilities of stakeholders are redefined according to the Action Plan | 15.5 | Implementation of the Action Plan | Prepare for implementation |
| | | **Detailed Project Document** | | | | |
| Implementation | S | Recruitment of contractors for building and O&M | | 11 | | |
| | T | Organisation of the sector, transfer of roles & responsibilities | FS management is transferred to the corresponding stakeholders | 11,12,13,16 | | |
| | U | Capacity building / information campaigns | Awareness is raised among users;<br>Capacity is built where needed | 16 | | |
| | V | Monitoring of construction | Building according to state-of-the-art is ensured | 11 | | |
| | W | Reassessment of key stakeholders before inauguration of the FSTP | Capacity of stakeholders to deal with their new roles and responsibilities is assessed | 15.5 | | |
| | X | Start-up of the system | The FSTP is brought to its state of equilibrium; stakeholders have acquired the necessary skills | 11 | | |
| | Y | Official inauguration ceremony | The FSTP is officially transferred to the city authorities / private entrepreneurs | | | |
| M&E | Z | Monitoring of the running system (technical stability, satisfaction of stakeholders, cost recovery) | The system is monitored to ensure its sustainability | 11 | | |

### Case Study 17.1: Leadership in the planning process

(Adapted from Parkinson *et al.*, 2013)

A planning process needs process leaders. There is never one single person responsible for FSM, but rather a web of stakeholders. Experience shows that the creation of a **city sanitation task force** is an effective means to engage with different institutions from the public and private sectors, and with non-governmental organisations (NGOs).

In order to develop a citywide sanitation plan there must be one institution that provides leadership; this is essential to ensure that the planning process maintains a clear direction and subsequently achieves the objectives agreed by the key stakeholders. In most situations, the most appropriate leader of the sanitation planning process is the local authority. If the planning process is driven by external agencies and in too short a time scale, the plan will invariably lack local ownership and there will be no incentive to move forward with the implementation of the plan.

It is necessary to ensure that there is sufficient commitment and communication between the different stakeholders prior to embarking on the planning process. During the consultation process, there must be sufficient time and opportunity for all the stakeholders to be involved. There is also a need for the planning process to be properly facilitated in order to guide and support interaction and communication between stakeholders. It is therefore important to identify the right individuals and institutions that have these skills. This may be technical support or skills such as stakeholder coordination, conflict resolution and community organisation.

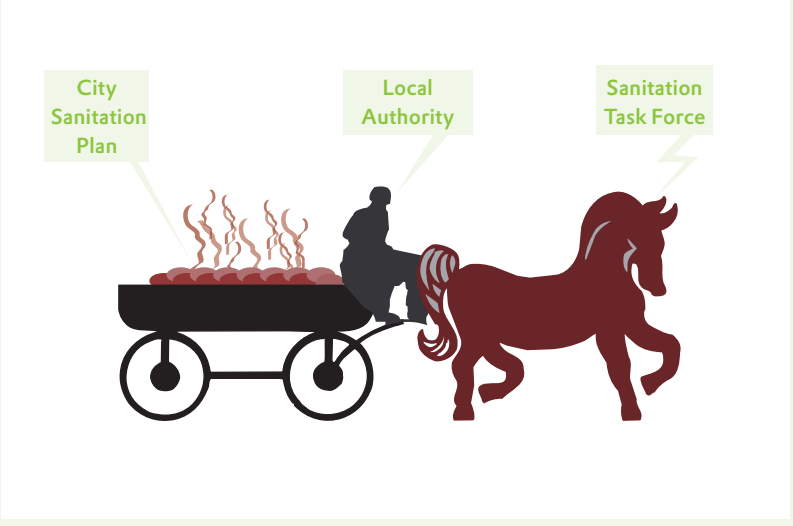



Figure 17.2 A representation of three key elements in the planning process: the city sanitation plan, local authority and a sanitation task force (adapted from Jonathan Parkinson).

## 17.2 NEED FOR AN INTEGRATED APPROACH

In the past, many water and sanitation projects have failed because of the lack of an integrated approach (Box 17.1). The development of physical infrastructure is only one component of a functioning FSM program, which also depends upon sustained public sector commitment and funding, effective policies, appropriate implementation and compliance enforcement (AECOM and SANDEC/EAWAG, 2010). Common reasons for failure are the implementation of infrastructure without consulting the main stakeholders or without planning adequate operation and maintenance (O&M) and financial schemes. Besides lack of institutionalisation of the system, lack of skills, insufficient organisational capacity and lack of cost-recovery mechanisms are also recognised as major factors in failure. Broadly speaking, it is possible to say that the enabling environment necessary for a functioning FSM system was either not there in the first place, or was not developed as an integral part of the project.

The lack of an enabling environment should not be considered as a reason for not engaging in a city because activities such as planning the O&M, defining roles and responsibilities, and structuring financial instruments for cost recovery can be structured into the project design. A bit more time and resources invested in the preliminary phase of the project can save a lot of time and money during and after implementation. In addition, a careful assessment of the initial situation (Chapter 14) and involvement of stakeholders (Chapter 16) will ensure a more appropriate selection of technical options and also provide insight into the presence (or absent) of the fundamental conditions necessary for an enabling environment (Section 17.2.1).

### BOX 17.1 : Examples of project failure due to lack of an integrated approach

Successful citywide sanitation projects in low-income countries are few and far between. Failed projects are the norm rather than the exception. In most cases, the reason is to be found in the lack of an integrated planning approach. Here are a few examples:

- A faecal sludge treatment plant (FSTP) was constructed 15 km from the city centre. Given the local context and the situation of the faecal sludge (FS) collection and transport service providers, this distance was too great, and the FSTP never received any sludge. Involvement of the FS collection and transport service providers in the planning process would have avoided this failure.

- Lack of O&M of a well-functioning FSTP led to a total breakdown. This was due to the lack of a clear definition of roles and responsibilities in the FSM scheme and a strict O&M plan which resulted in the municipality destroying portions of drying beds, and prevented relatively minor repairs from taking place (Case Study 12.2). Instead of taking simple action, stakeholders allowed the situation to deteriorate.

- A co-composting facility closed because no financial analysis had been carried out beforehand. The project designers had not taken into account the significant O&M costs for such a facility or the market demand for compost, and the sale of compost alone could not cover the operating costs.

- Large donors did not coordinate among their projects, leading to patchwork action instead of a sound city-wide sanitation plan.

Experience can also be drawn from wastewater projects (ADB, 2006), especially regarding user needs and constraints and treatment plants' O&M requirements.

Figure 17.3 A non-functioning treatment plant in Yaoundé, Cameroon (photo: Linda Strande).

### 17.2.1 Understanding and working towards an enabling environment

The major barriers to progress in sanitation coverage lie within the institutions, policies and realities of low- and middle-income countries (Lüthi *et al.*, 2011a). The public sector is often weak in terms of skills, structures, planning capacity and bureaucratic procedures, and mechanisms are not always in place to recover investment, operation or management costs, leading to a degradation of service provision or even system failure. Developing a national capacity to bring about change is therefore crucial. This needs to include the building of capacity and skills, introducing changes to organisational culture, developing nation-wide policies and providing sufficient financial resources.

An enabling environment is critical for the success of any type of investment, whether this is for the improvement of a single public latrine or for a city-wide FSM system (AECOM and SANDEC/EAWAG, 2010; Lüthi *et al.*, 2011a; Lüthi *et al.*, 2011b). Without it, the resources committed to bring about change run the risk of not being effective. Understanding the conditions necessary in a particular context for the environment to be enabling is part of an integrated approach. Once those are understood, measures to fulfil them should be an integral part of the project for it to be sustainable.

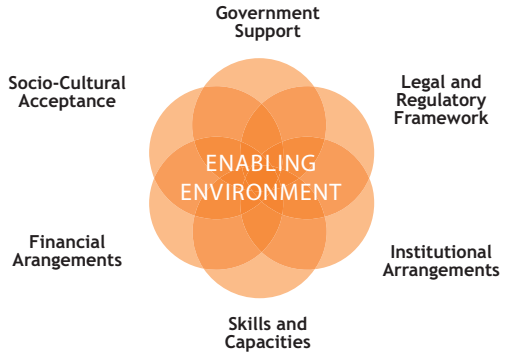



Figure 17.4 Components of an enabling environment (adapted from: Lüthi *et al.*, 2011a).

In order to understand the large variety of potential influences, the enabling conditions are classified into six categories, as shown in Figure 17.4 (Lüthi *et al.*, 2011a): 1) Government support, 2) Legal and regulatory framework, 3) Institutional arrangements, 4) Skills and capacities, 5) Financial arrangements, and 6) Socio-cultural acceptance.

Government support: Conflicting political priorities and therefore, a lack of explicit political support, is often the initial cause for project failure. Enabling government support includes not only relevant national policy frameworks and sector strategies, but also receptive local authorities and decision-makers.

Legal and regulatory framework: The technical norms and standards that influence the types and levels of service that are put in place are clearly important. Typical problems include regulatory inconsistencies, lack of regulations or unrealistic standards. A further issue in many countries is the poor enforcement of existing regulations. For the legal framework to contribute to the enabling environment, it must be transparent, realistic and enforced.

Institutional arrangements: Public institutions and private actors are integral to an enabling environment and getting the institutional environment right is a key ingredient for the sustainable delivery of sanitation services (see also Chapter 12). This encompasses the correct understanding of roles and responsibilities and capacities of each stakeholder, as wel as their influence and interest in improving service provision. A potential obstacle may be overlapping mandates between different institutions and ministries.

Skills and capacities: Developing the required skills and capacities at all levels is a key requirement and an issue that can take considerable time to develop. Identifying capacity gaps, particularly at district and municipal level, and then filling the gaps with tailored training courses, on-the-job training, etc. is a prerequisite (see also Chapter 16).

Financial arrangements: Implementing and maintaining environmental sanitation services is costly and requires an enabling financial environment. Financial contributions and investments are required from users, from government agencies and from the private sector (see also Chapter 13).

Socio-cultural acceptance : Achieving socio-cultural acceptance depends on matching each aspect of the proposed sanitation system as closely as possible to the users' preferences. Failure to ensure that the implemented solution is socio-culturally embedded is one of the most common reasons for past project failure (see also Chapter 15).

If they are absent, conditions for an enabling environment should be created before going any further into implementation and need to be addressed as part of the initial stage(s) of the planning process[1].

**Case Study 17.2: Difficulties in creating enabling institutional arrangements**
(Adapted from Lüthi *et al.*, 2009)

Changing the status quo when dealing with institutional arrangements is not easy. Often the decision-making and selection of options is heavily influenced by vested interests and local politics.

A challenge that informal or quasi-formal service providers often face when dealing with the leading sector institutions (i.e. commercialised or public utilities), which have a *de facto* monopoly, is to change the 'business as usual' mode of doing things. For example, in an East African town, the municipal utility carries the term 'sewerage' in its name and was mainly interested in expanding its sewerage network to all the planned areas of town, even though almost 90% of the city's citizens continued to rely on onsite systems such as septic tanks and simple pit latrines. Trapped in the rigid definition of its sewerage mandate, this municipal utility would not consider managing FS at the time. Changing the status quo would have meant starting a lengthy advocacy process with the utility and the overarching governmental agencies.

A few years later, the government overcame this problem with new national legislation, entrusting national utilities, and not municipal utilities as before, with the mandate to manage FS.

### 17.2.2 The importance of a participatory approach

Imposing a blueprint system from the top down is invariably prone to failure, even if it has succeeded in other locations. Institutions and the mindsets of people working for these institutions may not be ready, skills may not be there, and a number of stakeholders that previously made a living out of activities related to sanitation are excluded. Blueprint systems usually turn out more expensive than systems designed specifically for the local context.

In order to find out the most appropriate and cost-effective system, all stakeholders should be involved (Chapters 15 and 16), and competencies should be sought. For example, the current emptying service providers, even if they do not have a legal status, will be the most knowledgeable people regarding the collection of FS. Sometimes it may be difficult for utilities or governmental agencies to give up or to delegate some of their power and responsibilities. However, it is the price to pay for a cost-effective service with broad coverage. It is important that FSM be government or utility driven, but inclusion of other stakeholders is usually necessary to fill in the gaps of state service provision. Private public partnerships (PPPs) are synergies that need to be investigated.

[1] To learn more about the enabling environment, see also two reference publications, available at www.sandec.ch
- Lüthi *et al.* 2011a, Community-Led Urban Environmental Sanitation Planning: CLUES, p. 49-65.
- Lüthi *et al.*, 2011b, Sustainable Sanitation in Cities - a Framework for Action, p. 127-133.

Figure 17.5 A stakeholder workshop in Nepal (photo: Lukas Ulrich).

Sometimes sanitation development is either impeded or made impossible by institutional relationships resulting from stakeholders seeking personal prestige rather than public welfare. It is the role of external agencies (donors, consultants, and NGOs) to bring these stakeholders together and show that collaboration is a win-win process. The role of such agencies to advocate for integrated approaches and to push for positive change must be highlighted.

Many institutions and agencies may be reluctant to engage in a participatory process, arguing that it takes time and money. However, although participation has a cost, the benefits greatly outweigh the costs through increased potential for the system to succeed.

### Case Study 17.3: City sanitation plans – the Indonesian case study

(Adapted from WSP, 2009 and WSP, 2010)

It is becoming clear that the problem of urban sanitation is not only a lack of investment; but also the lack of a plan. There is a growing awareness worldwide of the need for integrated 'city-wide sanitation strategies' or 'city sanitation plans' as a prerequisite for sound sanitation investment. India and Indonesia, for example, have taken important policy steps in this direction. Governments need to develop both incentives and obligations for municipalities to adopt comprehensive strategies, by linking sectoral funding to the adoption of a city sanitation plan.

The Indonesian Sanitation Sector Development Program (ISSDP) is an innovative response to the growing sanitation crisis. Instead of funding investments directly, it fosters an enabling environment for progress, with special focus on city-level planning, strengthening sector strategy and institutional arrangements, and advocacy and awareness-raising at all levels. Central to the process is collaboration between the various government organisations.

ISSDP has tried, through the planning process, to directly address the shortcomings of existing sanitation services in the cities, particularly poor inter-agency coordination, a history of *ad hoc*, supply-driven investments and a deficient information base for decision-making. Thus, it avoids 'blueprint' approaches to infrastructure development that treat the city as a blank sheet on which completely new services should be imposed. Instead, it starts from an analysis of what already exists, and then considers how this could be improved in incremental steps, if and when funds become available and municipal capacity grows. It seeks to enhance synergy among the key stakeholders, develop sanitation in all parts of the city and create opportunities and incentives for private sector initiatives. Finally, the plan is translated into recurring annual action plans that can be implemented in given budget years.

The process is led by a city-level **sanitation working group**, endorsed by city leaders and composed of members from the municipal agencies, the private sector, NGOs and community groups and it is supported by a full-time facilitator. The sanitation working group does not replicate the roles of existing sector agencies, but helps to coordinate stakeholders to accelerate sanitation planning. The main challenges lay in creating local ownership of the planning process (due to the expectation that donor-funded consultants will cater for everything) and in institutionalising the group. There is always a risk that the parent organisations (which control staff and budgets) will adopt a 'business as usual' stance, irrespective of the plans that have been developed.

The plan is helping to elevate the profile of sanitation issues in the eyes of urban stakeholders and to address the gap between huge up-front investment projects with poorly targeted investments and small-scale community-based programmes that are failing to make a significant impact.

Figure 17.6 A narrow street in Indonesia (photo: Maren Heuvels).

## 17.3 PROPOSAL OF A PLANNING APPROACH AND LOGICAL FRAMEWORK

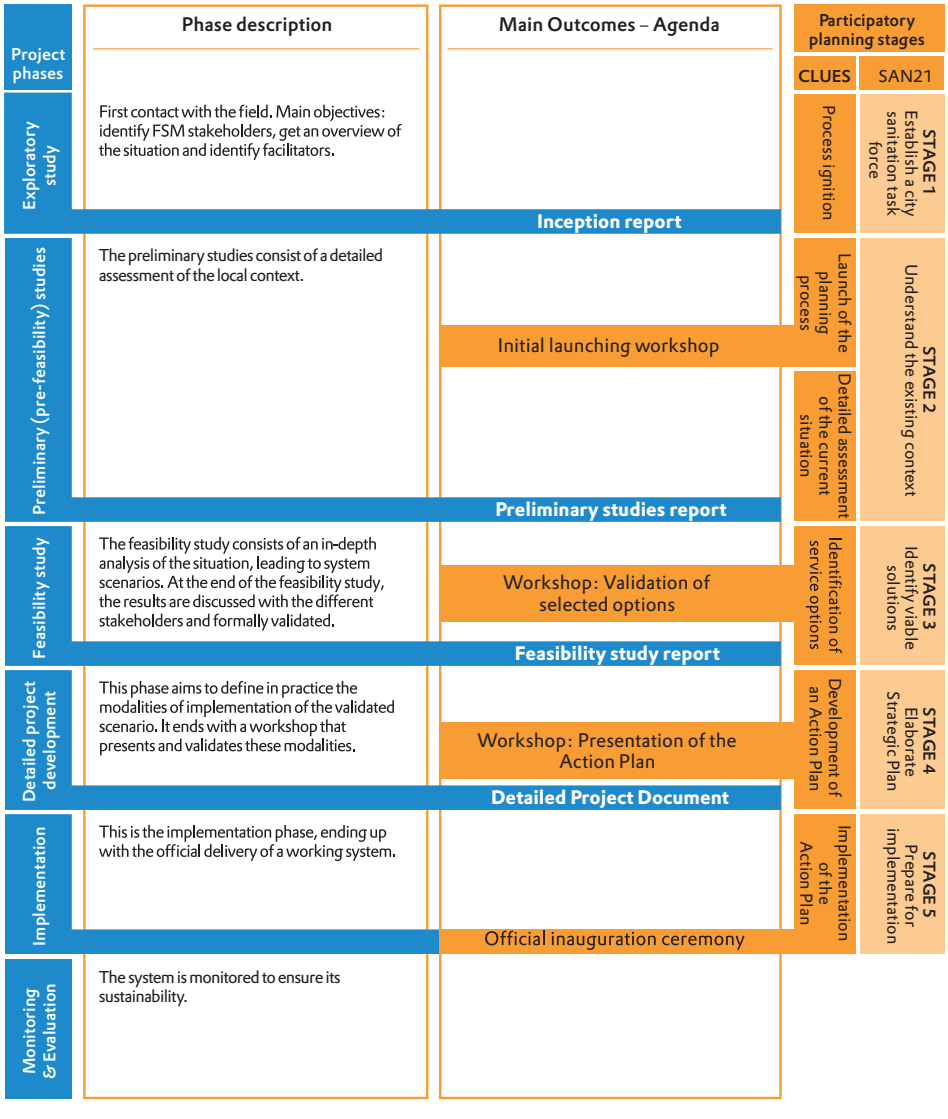
For an integrated and participatory approach to be applied, it has to be embedded in the initial project design (e.g. project proposals, Terms of Reference). ADB (2006) proposes an example of a more integrated terms of reference for assisting in project preparation. Time and money have to be allocated for the activities aiming to involve stakeholders and a provision has to be made to hire relevant social consultants. It also implies careful planning of the activities in order to allow effective coordination between the different consultants. Coordination is often a major shortcoming of big-donor projects where the different components are financed by different agencies. For this reason, it is important to have a clear plan of activities and a timeline from the start, and which all stakeholders agree upon.

In order to support FSM project design, a basis for a FSM project logical framework is proposed, structuring the activities and outcomes of FSM planning chronologically (Table 17.2, Project phases and participatory process stages), with reference to the corresponding sections in the book. The framework includes the participatory activities, reflecting the stakeholder analysis approach proposed in Section 15.5 and the involvement milestones described in Section 16.5. The different activities are fitted into the 'traditional' project phases and in the stages of recognised participatory planning approaches such as CLUES and Sanitation 21 (Lüthi *et al.*, 2011a; Parkinson *et al.*, 2013) – the link with the two latter being developed in Case Study 17.5. 'Traditional' project phases (exploratory study, preliminary studies, feasibility studies, detailed project development, implementation and monitoring and evaluation) and stages in participatory planning approaches (launch of the planning process, detailed assessment of the current situation and user priorities, identification of service options, development of an Action Plan and implementation of the Action Plan) follow a different but complementary logic, with slightly different main steps. They are compared side-by-side in Table 17.2, which describes briefly the main components of the "FSM planning from A to Z" framework (Table 17.1), and the main outcomes of each phase or stage are highlighted.

In the following sections, the logical framework is explained alongside the 'traditional' project phases. Several activities may be carried out in parallel, or in a different order to that listed here, according to the local context.

Figure 17.7 Narrow street in Raipur, India (photo: Philippe Reymond).

Table 17.2 Project phases and participatory process stages



### Case Study 17.4: Link with the global planning approaches CLUES and Sanitation 21

FSM planning is part of the larger framework of environmental sanitation planning, which includes city-wide wastewater, storm water and solid waste management. The prevalence of FS over wastewater varies from city to city. In West Africa for example, sanitation planning is clearly oriented towards FSM planning.

Several approaches have been developed to help planners in defining appropriate management strategies (McConville *et al.*, 2011). They differ in the spatial level they address (households, communities or city as shown in Figure 17.8) and the planning perspective (bottom-up vs. top-down). Such distinctions in level help the process leaders to simplify and organise their work by breaking down the process spatially and temporally. Each city unit should be dealt with separately in the first phase, while at the same time dealing with city authorities. For each component, corresponding methodologies may be used. Then the different pieces of the puzzle will come together to form a city-wide FSM system.

The planning model proposed in this book encompasses the entire system and tries to link the different global planning approaches such as Sanitation 21 and CLUES in the specific field of FSM. The Sanitation21 planning framework (Parkinson *et al.*, 2013) and the Citywide Sanitation Strategy (WSP 2010) are city-wide infrastructure planning approaches. The CLUES (Community-Led Urban Environmental Sanitation) guidelines (Lüthi *et al.*, 2011a) developed by EAWAG/SANDEC are complementary to these and address planning at the community level (Figure 17.8).

FSM planning links both levels, as the management needs to be organised city-wide, but in very close relationship with the users, e.g. the households, manual and mechanical operators or endusers. CLUES methodology may be used to assess user priorities in medium-sized cities and low-income areas. It should be adapted for cases where stakeholders are too numerous to be dealt with individually and have to be organised in associations, which is the case in most larger cities and districts within cities. In these circumstances Sanitation 21 can provide guidance on how to translate user priorities at the city-wide level while dealing with the municipal authorities.

In FSM, mechanical and manual emptying service providers and endusers stand at the interface between both levels. Building a management interface in this case means organising and giving a voice to those groups at the decision-making level. In parallel, the financial mechanisms bind the whole system together.

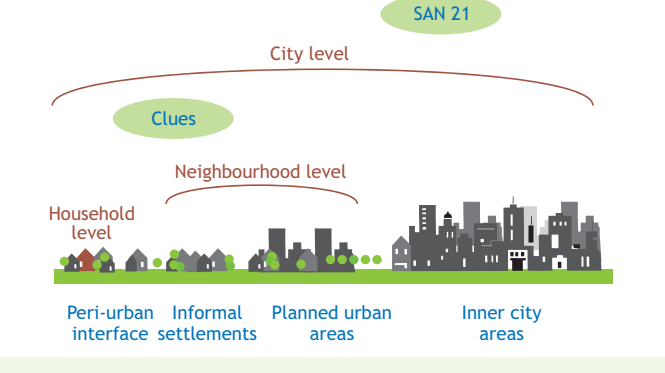



Figure 17.8 Planning contexts (figure: SANDEC).

### 17.3.1 Exploratory and preliminary studies

The exploratory study is usually short (e.g. two weeks) and should focus on establishing lines of communication with potential partners (including the authorities), a first inventory of the stakeholders and a preliminary assessment of the current situation (Chapter 14). Process leaders should make field trips and transect walks (Section 16.4), and visit disposal sites. It is important to try and obtain the opinion of as many stakeholders as possible. It is also important to identify facilitators for the next steps of the project, i.e. people who are familiar with the situation and have easy access to the different stakeholders.

Preliminary studies should start with the identification and preliminary characterisation of the stakeholders (Sections 15.3, 15.4 and 15.5.1) and the relationships between them. It is recommended that they are all invited to a launching workshop (Section16.5), where everyone can develop a common understanding of the situation in the intervention area, as well as agree on the process of how to solve the problems (Gutterer *et al.*, 2009; Lüthi *et al.*, 2011a). This common understanding is very important and can never be assumed. Experience shows that many stakeholders are usually not aware of the situation, especially among local authorities. For this reason, it is recommended that a field visit for all stakeholders is included as part of the workshop in order to raise awareness.

Government and utility representatives should be involved in the launching workshop to avoid potential conflicts with existing policies, regulations and municipal by-laws. It will also help clarify the available support and skills at municipal or district levels (Lüthi *et al.*, 2011a). This workshop should also aim at (Gutterer *et al.*, 2009):

- creating awareness amongst decision-makers on legal requirements, required resources and institutional backing;
- developing a supportive environment and getting different stakeholders and authorities to offer their competencies; and
- launching a process for the provision of financial and human resources at different government levels.

Once all stakeholders are sensitised to the sanitation reality and aware of the project objectives, it will be much easier to collect information for the preliminary and feasibility studies. It is often not easy to access data, especially where 'information is power', and it is important to make key contacts and build trust through transparancy.

Chapter 14 describes how to carry out a detailed assessment of the current situation. Outputs should include a refined stakeholder analysis, baseline data, as well as a thorough assessment of the enabling environment (Section 17.2.1) and current levels of service provision (Lüthi *et al.*, 2011a). It is also important to select possible organisational modes (Chapter 12) and potential treatment sites (Section 14.4), as the range of options available may significantly influence the technology selection. This is illustrated in the Technology Selection Scheme (Figure 17.10). The assessment should be based upon a participatory process (using semi-structured interviews, focus group meetings or household surveys, Section 16.4), because each stakeholder has specific experience and knowledge of the situation. They also have particular interests and needs that must be taken into consideration (Section 15.4).

At the end of this phase, the process leaders should have a clear idea of feasible options and key stakeholders. This book proposes an iterative methodology to identify, select and characterise the relevant stakeholders (Section 15.5). Such a systematic approach is important in order to identify any threat or opportunity and assess the influence and interest of stakeholders in the project, especially those linked with potential management and institutional arrangements. This approach can avoid many problems in later stages of the project.

### 17.3.2 Feasibility study

The main result of the feasibility study is the identification of viable system options. This phase starts with the quantification and characterisation of sludge (Chapter 2), as a prerequisite for the selection and design of technical options (Section17.4). Quantities and characteristics are specific to each city. Such a study requires time and should be planned accordingly. A characterisation and selection of sites (Section14.4) should also be made as this may influence the viability of different technical options.

Based on this and the information collected during the preliminary studies, technical, organisational and financial options can be pre-selected and studied in-depth, and discussed in a participatory manner. It is critical to recognise that FSM planning is about the combination of services, not about single technologies (Section17.4.1). Each aspect influences and is influenced by the others. Each scenario should be evaluated in detail as follows:

- requirements of technology combinations, pros and cons, O&M (Chapters 4 to 11);
- management and institutional setup; roles and responsibilities; contractual arrangements (Chapter 12 and Section 16.6);
- capital and operation costs, financial mechanisms, estimated budget (Chapter 13);
- capacity building and training needs (Section 16.5.3); and
- environmental impact assessment (often legally required).

Each scenario should be examined in conjunction with the checklist of the enabling environment (Section17.2.1). If an aspect of the scenario does not fit, it should either be adapted or activities should be carried out to create the missing conditions. In particular, support from the authorities should be secured, training should be planned to provide all the skills required and the system should be financially sustainable. The strengths, limitations and implications of the preselected systems should be assessed.

It is important to involve the key stakeholders in the evaluation (Chapter 16), as they will have to take over the roles and responsibilities of the system. It is also important that stakeholders are properly informed. The agreement reached by the stakeholders should be based on an understanding of the management and financial implications of the selected systems.

At the end of the phase, it is recommended to organise a **validation workshop** with all the key stakeholders, in order to **publicly** and **officially** present and validate the decisions taken. Any disagreement from important and/or influential stakeholders should be cleared **before** the public workshop.

The feasibility study report should state clearly who the main stakeholders for the next phase will be. For this reason, it is recommended at this point to reassess the interest and influence of the key stakeholders according to the validated options. A categorisation of the stakeholders is proposed in Section 15.4.3 in order to structure the involvement needs for the action planning.

### 17.3.3 Detailed project development – Action Planning

Based on the options validated in the previous phase, a Detailed Project Document, or Action Plan, can be developed. This document should include the following items:

- detailed design of the treatment plant;
- detailed definition of roles and responsibilities in the new system and terms of references;
- O&M management plan with a clear allocation of costs, responsibilities and training needs;
- agreements between stakeholders, securing financial and institutional mechanisms;
- strategy for control and enforcement: including the frequency of control, means needed and sanctions;

- definition of needs for capacity building and job creation;
- definition of contracts and bidding processes;
- monitoring and evaluation strategy for the implementation phase; and
- timeline for implementation with distinct phases and an itemised implementation budget.

O&M is often a cause of failure in development projects and thus the O&M management plan is particularly important (Chapter 11). It should include (Lüthi *et al.*, 2011): 1) O&M tasks, including routine inspection and maintenance, periodic maintenance, and urgent maintenance; 2) administrative tasks, including book-keeping, collecting fees, annual budgeting, paying employees, dealing with complaints; 3) reporting procedures; 4) responsibilities of all parties concerned; and 5) training activities for responsible persons. Key stakeholders should be reassessed according to the definition of roles and responsibilities (Section 15.5.4).

The Detailed Project Document/Action Plan should be presented, discussed and validated in a workshop with all the key stakeholders. Several workshops may be needed until a consensus is reached.

### 17.3.4 Implementation

This phase is mainly about translating the Action Plan into work packages that will ultimately become contracts for implementing the FSM system (Chapter 11). Several arrangements are applicable for the implementation of the plans, the most common being through private sector contractors based on competitive tendering and bidding procedures.

In parallel to this process, stakeholders should be organised according to the Action Plan. If needed, the legal and regulatory framework should be adapted. According to the identified needs, capacity building should be provided for a smooth transfer of roles and responsibilities (e.g. Section 16.5.3). The public should also be properly informed about the new FSM system and the improvements being carried out in their municipality. This will increase awareness and ownership by the public as well as by the authorities.Before the inauguration of the FSTP, the strengths, weaknesses and training needs of key stakeholders should be reassessed (Section15.5.5). At this point there is still time to organise further training and adapt the capacity-building strategy.

After the finalisation of the construction works, the whole system (i.e. infrastructure and stakeholders) requires a start-up phase for acclimatisation (Chapter 11). For the FSTP, the start-up period will last until the system reaches its state of equilibrium and expected performance. For example, with planted drying beds, the acclimation of plants is a delicate operation that should not be neglected (Chapter 8). As for the stakeholders, they will need some time to get used to their new roles and responsibilities, and some adjustments will certainly be needed in the first few months. Support from the project team is essential at the beginning of the operational phase.

Finally, an inauguration ceremony can be organised. Such an event can generate public interest and increase awareness and can also have a positive influence on institutional decision-makers (Lüthi *et al.*, 2011a).

### 17.3.5 Monitoring and evaluation

Any FSM system should be monitored and evaluated (Chapter 11 and Figure 17.9). Many development projects have failed because there was no follow-up after commissioning of the FSTP. The stability of the FSTP treatment units, the satisfaction of stakeholders, the functioning of the organisational scheme, the cost recovery level and the sustainability of financial mechanisms should be monitored. Adjustments will probably still have to be made after commissioning.

Figure 17.9 Sampling in the field with a portable laboratory, Egypt (photo: Philippe Reymond).

Monitoring throughout the whole year is necessary, especially for the FSTP. Climate (heat, rain) can positively or negatively affect the treatment performance. The quantity and characteristics of sludge differ from one season to the other (especially between dry and rainy seasons - Chapter 2). This can also influence the performance of the FSTP, as well as the whole supply chain, as the demand for emptying services varies as well.

In addition, dissemination of lessons learnt is important to the development of FSM.

## 17.4 SELECTING CONTEXT-APPROPRIATE TECHNICAL OPTIONS

Setting up a FSM system is not only about the selection of single technological options, but more importantly, about finding a sustainable combination of services that guarantees the appropriate collection, conveyance, treatment and disposal or enduse of FS, in a way that ensures household satisfaction, broad coverage and cost recovery. In this book, an elimination-based approach is proposed, based on selection criteria and related critical parameters. This approach is context-specific and focusses on the enduse of endproducts.

### 17.4.1 Combination of services

A sound selection of combination of services can only succeed after a thorough assessment of the initial situation (Chapter 14), feasible modes of organisation (Chapter 12), potential financial arrangements (Chapter 13), existing sites (Section14.4) and stakeholder analysis and involvement (Chapters 15-16).

Table 17.3 Criteria for selection of treatment options

| Treatment performance | Local context | O&M requirements | Costs |
|---|---|---|---|
| ▪ Effluent and sludge quality according to national standards | ▪ Characteristics of sludge (dewaterability, concentration, degree of digestion, spreadability)<br>▪ Quantity and frequency of sludge discharged at the FSTP<br>▪ Climate<br>▪ Land availability and cost<br>▪ Interest in enduse (fertiliser, forage, biogas, compost, fuel) | ▪ Skills needed for operation, maintenance and monitoring available locally<br>▪ Spare parts available locally | ▪ Investment costs covered (land, infrastructure, human resources, capacity building)<br>▪ O&M costs covered<br>▪ Affordability for households |

The choice of a combination of services is influenced among others by the type of onsite sanitation systems (pit latrines, septic tanks, etc., Tilley *et al.*, 2014), the sludge quantity and characteristics (Chapter 2), rain patterns (quantity, distribution over time), the existing FS private sector and the institutional setting.

The assessment of available capacities and gaps is crucial. Ultimately, the success of a FSM plan largely depends on:

- the **capacity** of the stakeholders to **enforce the financial mechanisms** that have been planned, allowing cost recovery for the FSTP; and
- the **capacity** of the stakeholders to **operate and maintain the FSTP**.

Only an integrated approach can guarantee that, in the end, these capacities are present.

### 17.4.2 Criteria for selection of treatment options

A FSM system should be efficient and flexible, i.e. able to function normally and adapt to the frequency of sludge delivery and sludge quantities and characteristics, cope with climatic variations, produce endproducts that are safe for use, be able to guarantee that the investment and O&M costs are acceptable and that there are skilled employees for operation (adapted from Klingel *et al.*, 2002). Options for enduse and resource recovery (Chapter 10) should be promoted where there is an observed demand. This way, uncontrolled discharge of endproducts into the environment is avoided and nutrient enduse is maximised. Designing treatment technologies with the intended enduse in mind also helps to ensure that the technologies are not over- or under-designed to achieve the appropriate level of treatment.

Eleven criteria for the selection of a combination of technologies are proposed, divided into four categories: treatment performance, local context, O&M requirements and costs (Table 17.3). They should serve as guidelines. If one of these is not matched or not taken into account in the planning, a revision should be considered, as it could impact on the sustainability of the project.

### 17.4.3 Elimination-based approach

The integrated approach presented in this book emphasises the importance of the assessment of the initial situation, the financial, organisational and O&M realities, as well as the characteristics of the available treatment sites for selecting context-appropriate technology. The proposed Technology Selection Scheme (Figure 17.10 and Case study 17.6) takes the existing practices, user priorities and the enabling environment as the basis for selection. Once this assessment has been completed, the

elimination-based approach, based on qualitative technical decision factors, can be applied. After this, the process leaders must check if the selected options match the available skills, financial and organisational realities, as well as the potential treatment sites. If they do not match, the selection should be modified until a suitable combination is reached. It is therefore an iterative process, and ties various chapters of this book together by linking the different aspects of technology selection.

The selection process may take time, as all activities are run in parallel and defining a management scheme and an O&M plan with the FS stakeholders, or finding appropriate treatment sites are difficult tasks. However, as discussed in various case studies, these tasks must be finalised before taking the final decision on technical options as setting up a management scheme once the infrastructure has already been built, will result in failure of the FSTP.

Demand for endproducts is also highlighted in the scheme. Enduse can be, but is not necessarily, significant for the financial balance of the system (Chapter 13), but it increases safe disposal and the motivation of FSTP operators to deliver quality services, and offsets disposal costs. However, demand for enduse is one thing, satisfying it on the ground is another (Murray *et al.*, 2010). It is often forgotten that marketing an endproduct and making it available for the endusers also has a cost and that the endusers themselves, even if interested in the endproduct, may not be willing to pay for it, or may not have the capacity. Hence, distribution and logistics of treatment products to users is an important consideration.

### Box 17.2: How to use the Treatment Technology Selection Scheme (Figure 17.10)

The elimination-based approach is represented as a Technology Selection Scheme (Figure 17.10). The technical options are featured in blue boxes, and the potential endproducts in green boxes; the options in light blue and endproducts in light green represent promising perspectives that have not yet fully been validated for FS treatment. For the purpose of clarity, only key technical decision factors are represented and streams other than sludge, such as the liquid fractionfrom each option, organic waste or energy, are not represented. Decision factors are qualitative, not quantitative, as well-defined thresholds do not yet exist. More detailed information on technologies is found in Chapter 5.

The technologies are categorised according to their function, within the treatment process:

1 Solid-liquid separation
2 Stabilisation
3 Dewatering/drying
4 Pathogen reduction

If a technology has two functions, it lies at the interface between the corresponding sub-sections of the scheme. Technologies that can be combined are linked with arrows, representing sludge transfers.

The decision factors are studied during the detailed assessment of the initial situation (Chapter 14). The main factor is the quantity and quality of sludge (Chapter 2). Dewaterability of sludge is crucial, whether for intrinsic (concentration, degree of digestion) or external parameters (rain patterns) (Chapter 3 and Chapters 5-9). It determines if a solid-liquid separation step is needed or not. If yes, digesters, settling-thickening basins or onsite anaerobic baffled reactors (ABR) should be considered.

Sludge 'spreadability' and amount of precipitation are two decision parameters when choosing between planted and unplanted drying beds. Where there are periods of intense rainfall, planted drying beds are preferred, as the sludge residence time is much higher. However, where sludge is too thick to be easily distributed on planted drying beds, unplanted drying beds are preferred.

Dry sludge, humified sludge, biomass, biogas and compost are all possible endproducts (Chapter 10). Biogas can be produced if fresh sludge or sludge that is not fully stabilised is available and if the temperature is high enough. If organic waste is sorted and available, it may be possible to add it to a biogas digester or to co-compost.

Selecting options may be an iterative process, until the combination of technologies matches the requirements of the local context.

### 17.4.4 Sanitation system proposal

Communicating the results of the technology selection in a clear and systematic manner is key for the discussion of the proposals with the project stakeholders. The Compendium of Sanitation Systems and Technologies (Tilley *et al.*, 2014) provides a clear and easily readable way to show the value chain, from the type of latrines used to the selected treatment and enduse/disposal options. The value chain is divided into five sections: 1) user interface; 2) collection and storage/treatment; 3) conveyance; 4) (semi-) centralised treatment; and 5) use and/or disposal. Each existing or planned option is represented in its respective functional group and is linked to the following step by arrows and input/output product(s).

Box 17.3 provides an example of how a system proposal can be presented.

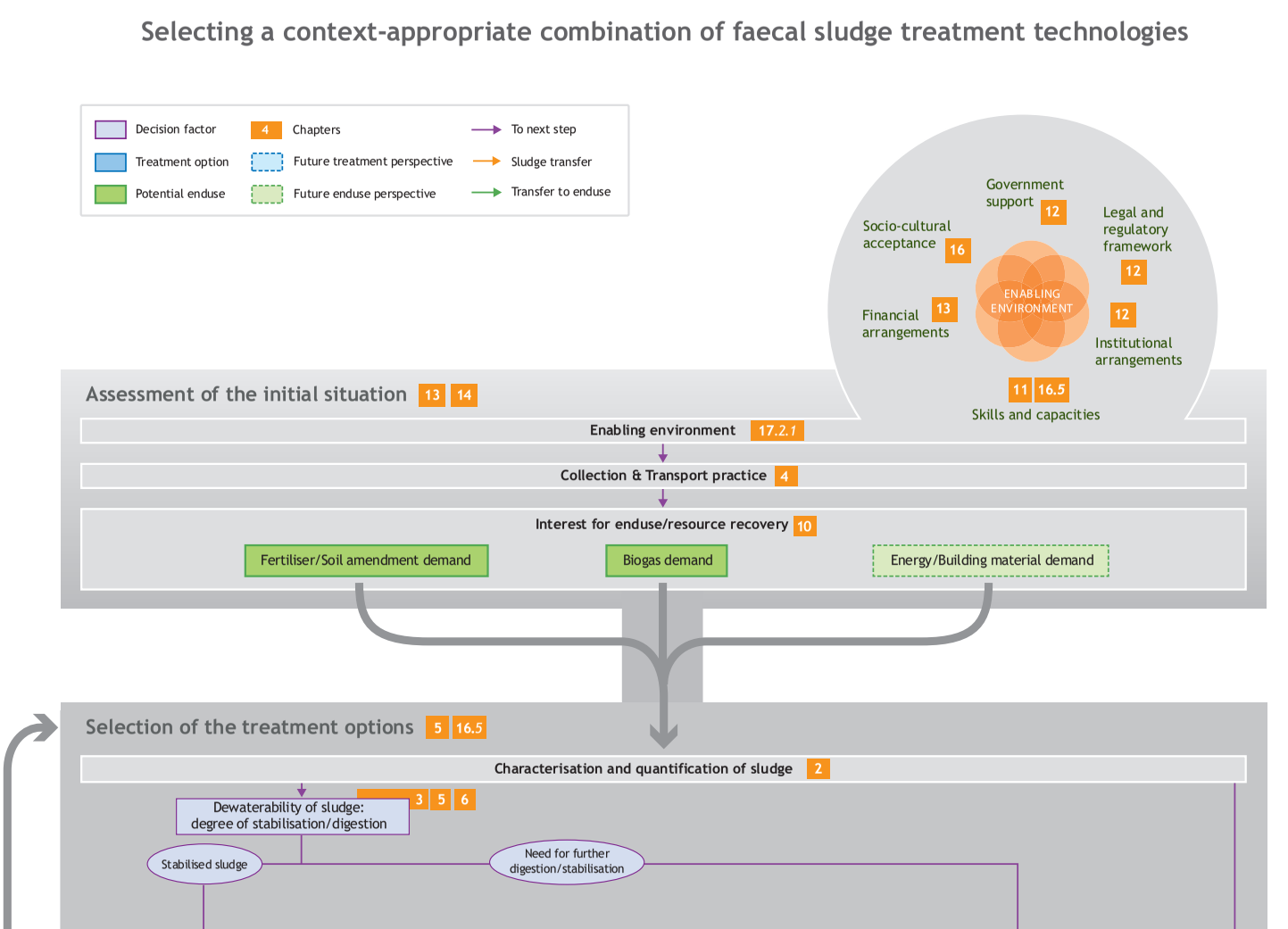
**Box 17.3: Example diagram of a sanitation system proposal**

The feasibility study for the implementation of a new FSM plan is being conducted in a Sub-Saharan city. The assessment of the initial situation (Chapter 14) showed that the population mainly relies on single pit and VIP latrines, with dry or pour-flush toilets according to the cultural background. Some well-off families as well as administrative and commercial buildings have septic tanks. Greywater is disposed of separately in open stormwater drains or soak pits, as is septic tank effluent. FS from the pits is mainly collected by mechanical providers, but a few neighbourhoods remain inaccessible to motorised vehicles and in these areas pits are emptied manually.

The Sanitation Task Force, in charge of elaborating a City Sanitation Plan, is proposing the construction of two FSTPs, one in the north and one in the south of the city. FS is to be conveyed by the existing private service providers. Transfer stations are to be built at the interface between the main roads and neighbourhoods served by manual service providers. Treatment in both FSTPs would be based on a combination of a settling/thickening basin followed by unplanted drying beds. The effluent is to be treated in a series of waste stabilisation ponds (WSP). Sludge collected from the drying beds is to be stored for at least six months before being sold to farmers. The effluent of the WSP would be discharged in a nearby stream or, during the dry season, used for irrigation. In the last pond, plant operators may possibly introduce aquaculture.

Planning for a meeting with the local authorities, the Sanitation Task Force has prepared a diagram of their sanitation system proposal in order to facilitate the presentation and discussion of the results. This is shown in Figure 17.11.

Figure 17.10 Technology Selection Scheme: How to select a context-appropriate combination of faecal sludge treatment technologies.



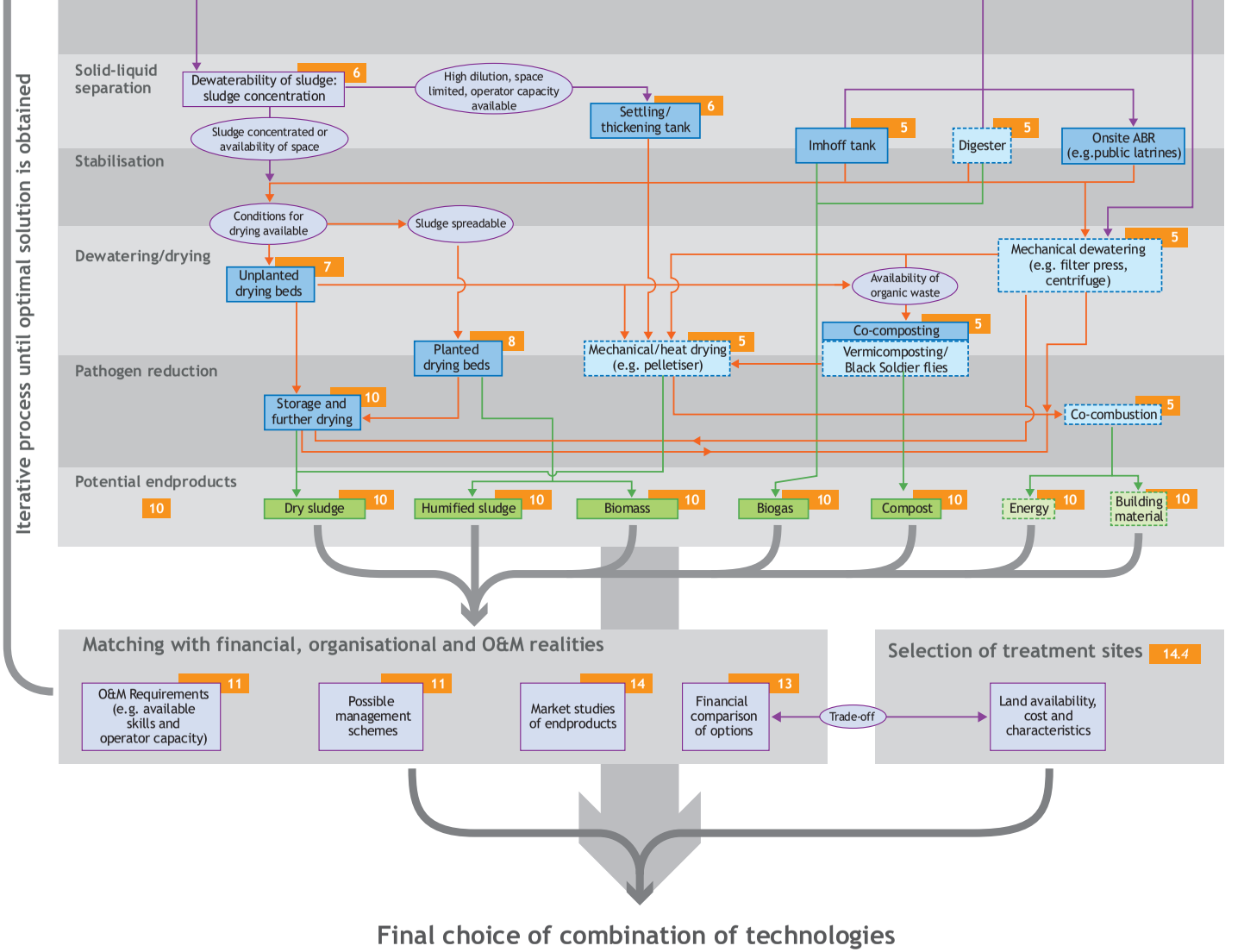
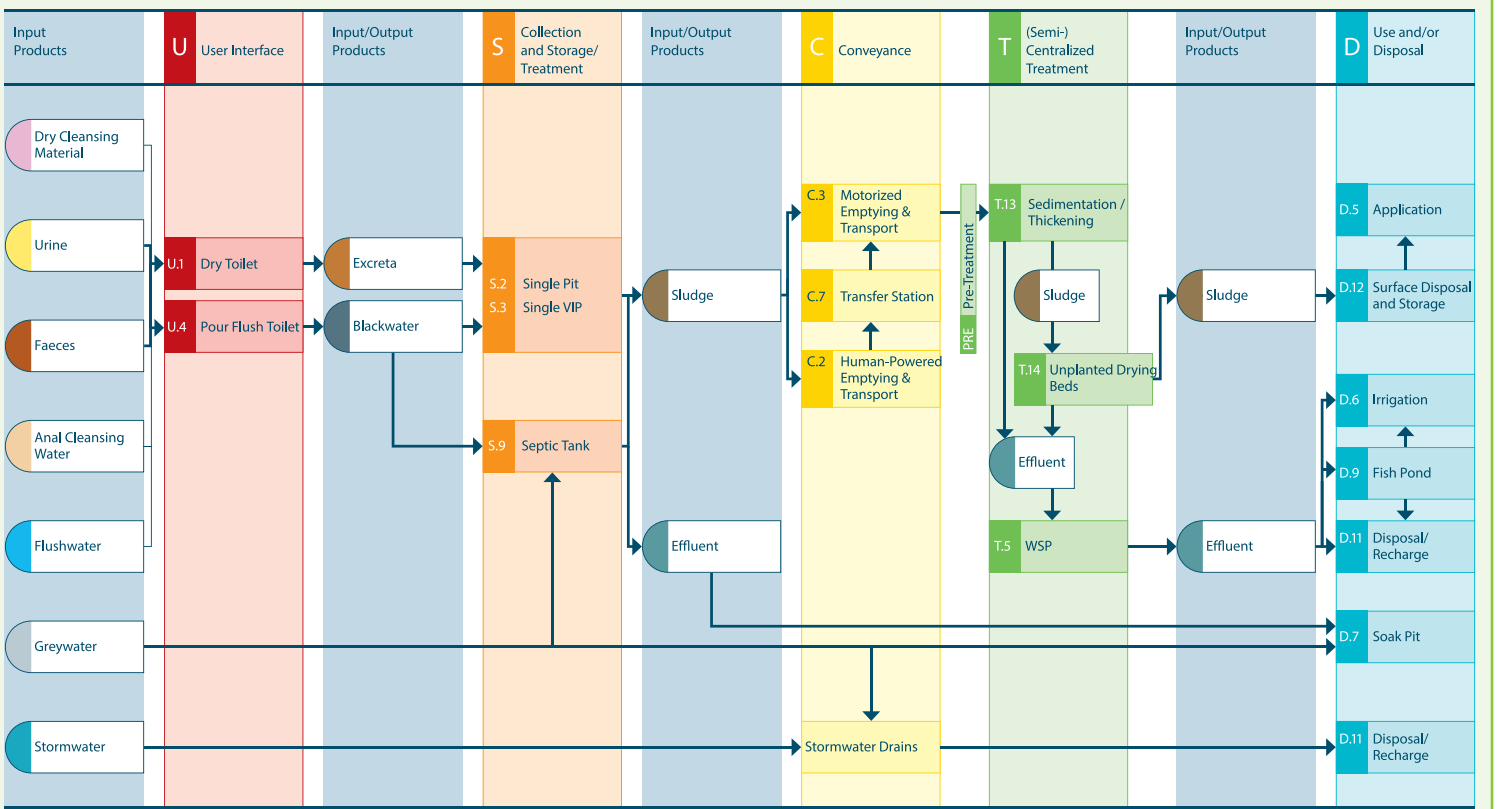

Iterative process until optimal solution is obtained
Solid-liquid separation
Stabilisation
Dewatering/drying
Pathogen reduction
Potential endproducts
10
Dewaterability of sludge: sludge concentration
6
High dilution, space limited, operator capacity available
Sludge concentrated or availability of space
Settling/ thickening tank
6
Imhoff tank
5
Digester
5
Onsite ABR (e.g.public latrines)
Conditions for drying available
Sludge spreadable
Unplanted drying beds
7
Mechanical dewatering (e.g. filter press, centrifuge)
5
Availability of organic waste
Co-composting
5
Vermicomposting/ Black Soldier flies
Planted drying beds
8
Mechanical/heat drying (e.g. pelletiser)
5
Storage and further drying
10
Co-combustion
5
Dry sludge
10
Humified sludge
10
Biomass
10
Biogas
10
Compost
10
Energy
10
Building material
10
Matching with financial, organisational and O&M realities
O&M Requirements (e.g. available skills and operator capacity)
11
Possible management schemes
11
Market studies of endproducts
14
Financial comparison of options
13
Trade-off
Selection of treatment sites
14.4
Land availability, cost and characteristics
Final choice of combination of technologies

Figure 17.11 Example diagram of a faecal sludge sanitation system proposal (adapted from Tilley *et al.*, 2014).



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